



Are SUVs Safer than Cars? An Analysis of Risk by Vehicle Type and Model

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by

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Context: Historical Trends in Vehicle Safety and Design

- Fatalities in head-on car-to-car collisions decreased dramatically over last 20 years
 - better restraint (seatbelts, airbags) design and more extensive use
 - better vehicle design
 - better roadway design
 - some of these trends influenced by NHTSA crash tests
- Fatalities in truck-to-car collisions increased dramatically
 - light truck (pickups, SUVs, minivans) market share increased to 50% of light duty sales
 - incompatibility between trucks and cars
 - higher bumpers
 - longitudinal rods in conventional pickups and many SUVs
 - higher weight
- We examine risk by vehicle type and model, both to drivers of vehicles and drivers of other vehicles

Definition of Risk

- “Risk”: driver fatalities per year, per million vehicles sold
- Similar to IIHS driver fatality rates (2000)
 - both use driver fatalities in NHTSA Fatality Analysis Reporting System (FARS)
 - many details on all US traffic fatalities, with varying degrees of reliability
 - IIHS uses registered vehicles as denominator, or measure of “exposure”
 - we use sales because readily available; hope to use registrations in future
 - ideal denominator would be annual vehicle miles traveled (although results would change only slightly)
 - IIHS analyzes many more models, over different time periods
 - our analysis limited to most popular models, over same five year period (1995-1999)
 - IIHS only analyzes risk to drivers of individual models
 - we also analyze risk to drivers of other vehicles (ala Joksche et al. 1998)

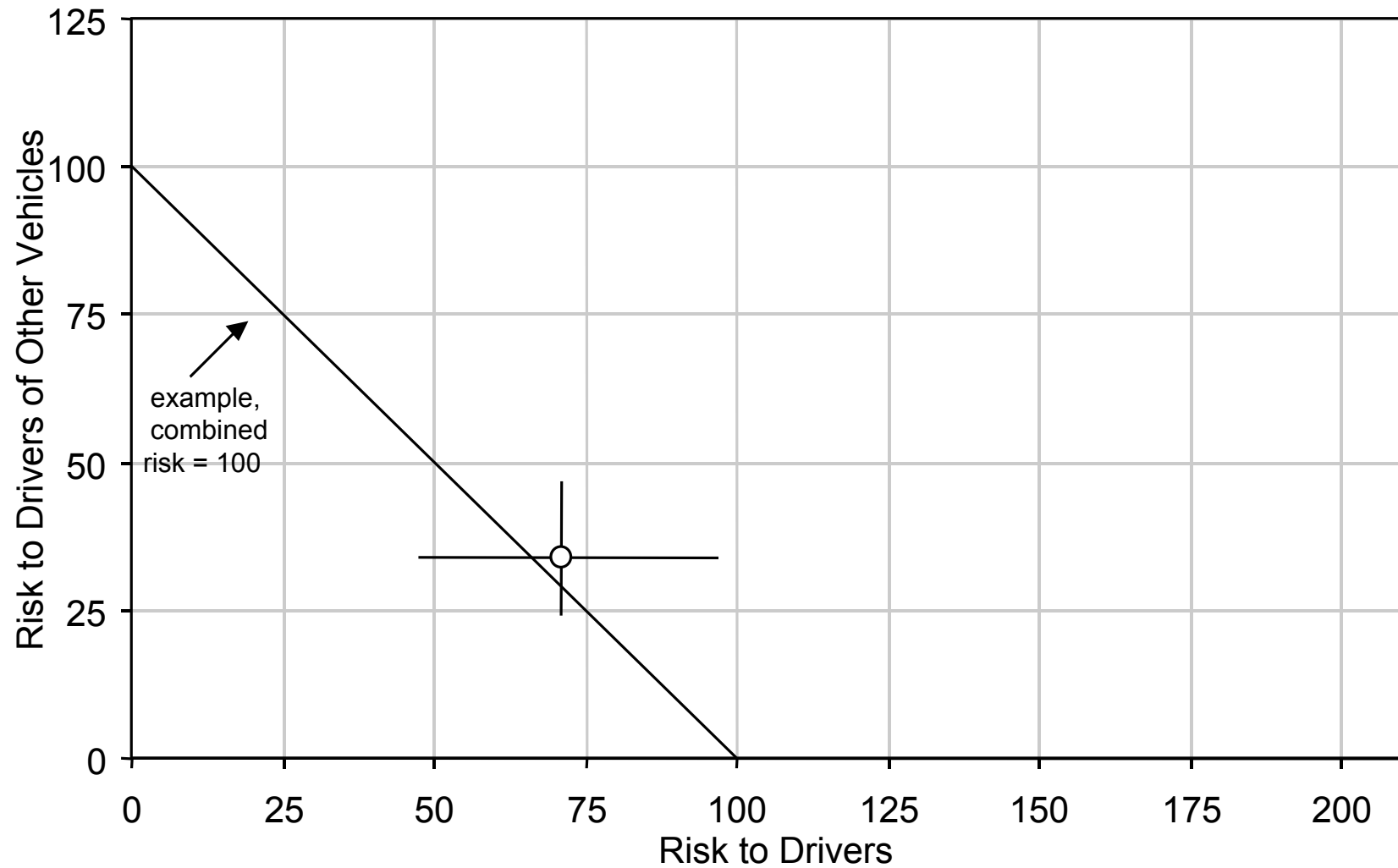
Definition of Risk (cont.)

- Our definition of risk incorporates:
 - vehicle design
 - driver characteristics and behavior
 - road environment and conditions
- Therefore, all risks are “as driven”

Two Types of Risk

- Risk to drivers of subject vehicle
 - from all types of crashes. Can also be calculated for two-vehicle crashes, one-vehicle crashes, rollovers, etc.
- Risk imposed by subject vehicle on drivers of other vehicles (all types and ages)
 - because from two-vehicle crashes only, risks to other drivers tend to be lower than risks to drivers
- Lines represent range in risk of individual models of each type (not statistical error)
- Combined risk is the sum of the risk to drivers and risk to others (shown by diagonal line)

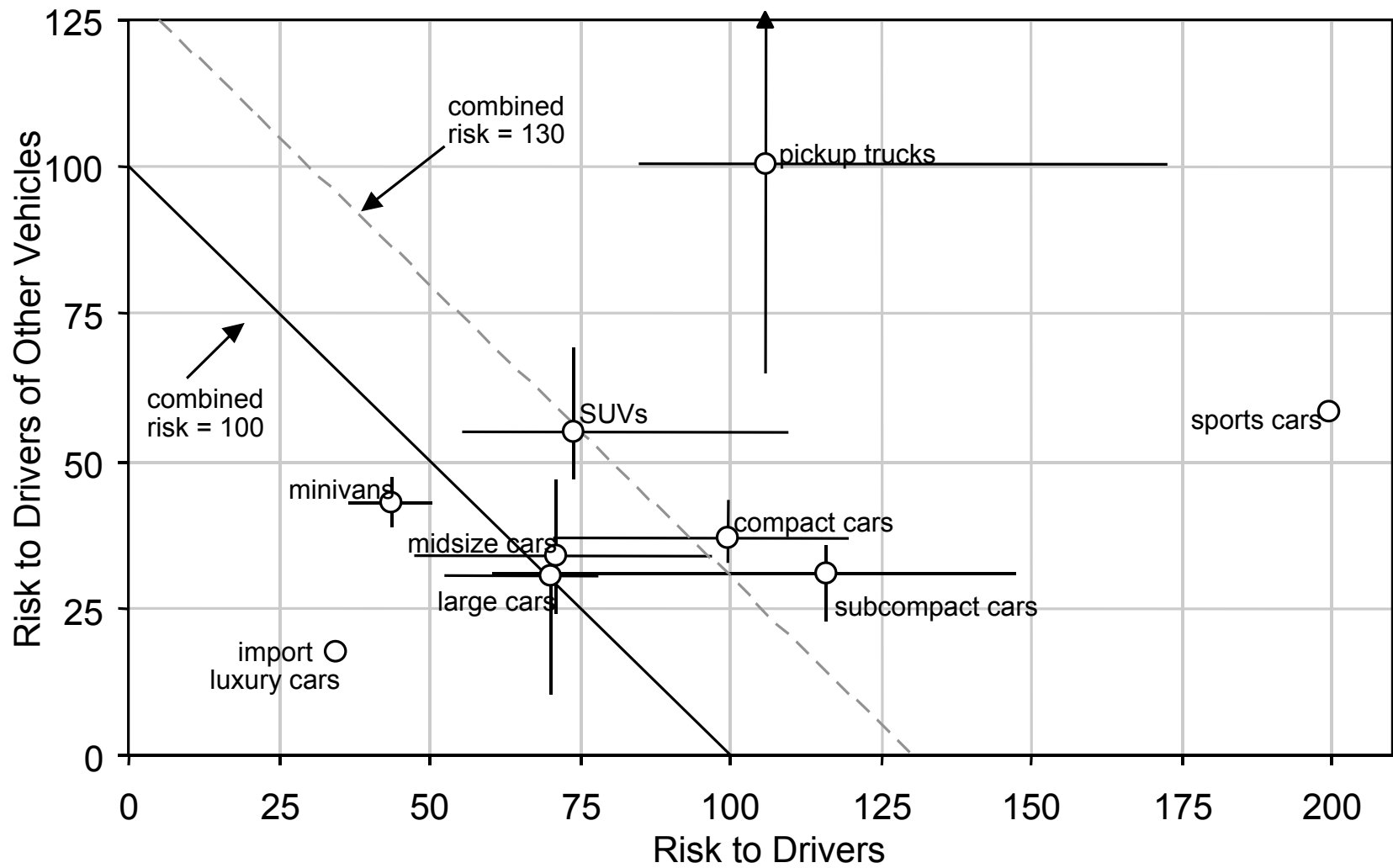
Sample Figure for Midsize Cars



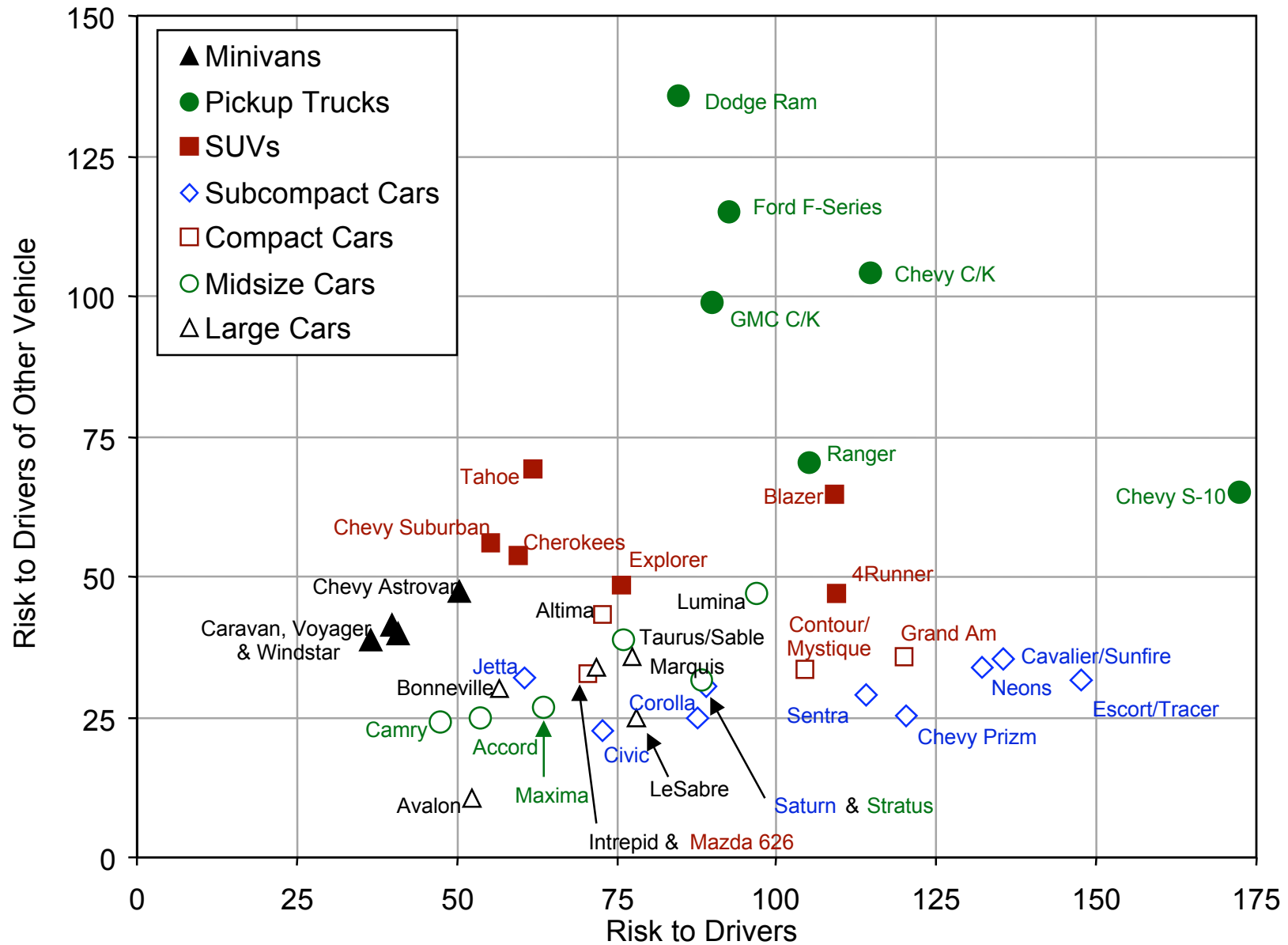
Two Levels of Analysis

- Risks by vehicle type
 - pickups, SUVs, and minivans
 - four major car classes (plus luxury import and sports cars)
 - calculated for 77 popular vehicle models with relatively consistent, strong sales over 1995-1999
 - differences less than ~10% not statistically significant
- Risks by vehicle model
 - calculated using only 40 most popular vehicle models, to reduce statistical uncertainty
 - differences less than ~20% not statistically significant
- Results are preliminary (to be revised using registrations)

Risks by Vehicle Type



Risks by Vehicle Model



Findings on Risk by Type

- Average midsize and large car
 - same average risk to driver as average SUV
 - lower average risk to others, and combined risk, than average SUV
- Average compact and subcompact car
 - higher average risk to driver than average SUV
 - lower average risk to others than average SUV
 - combined risk is comparable, or only slightly higher, than SUV
- Large range in risk to drivers of individual subcompact car models
 - Risk in Neon, Cavalier/Sunfire, Escort/Tracer 2-3 times that of Jetta and Civic
 - safest subcompacts and compacts have lower risk to drivers than average SUV
- Pickups have highest risk to others
- Import luxury cars have lowest risk to drivers and others

Effect of Vehicle Design on Risk

- Very high risk to others from pickups associated with chassis stiffness and height
- High risk to drivers of pickups and SUVs from their propensity to roll over

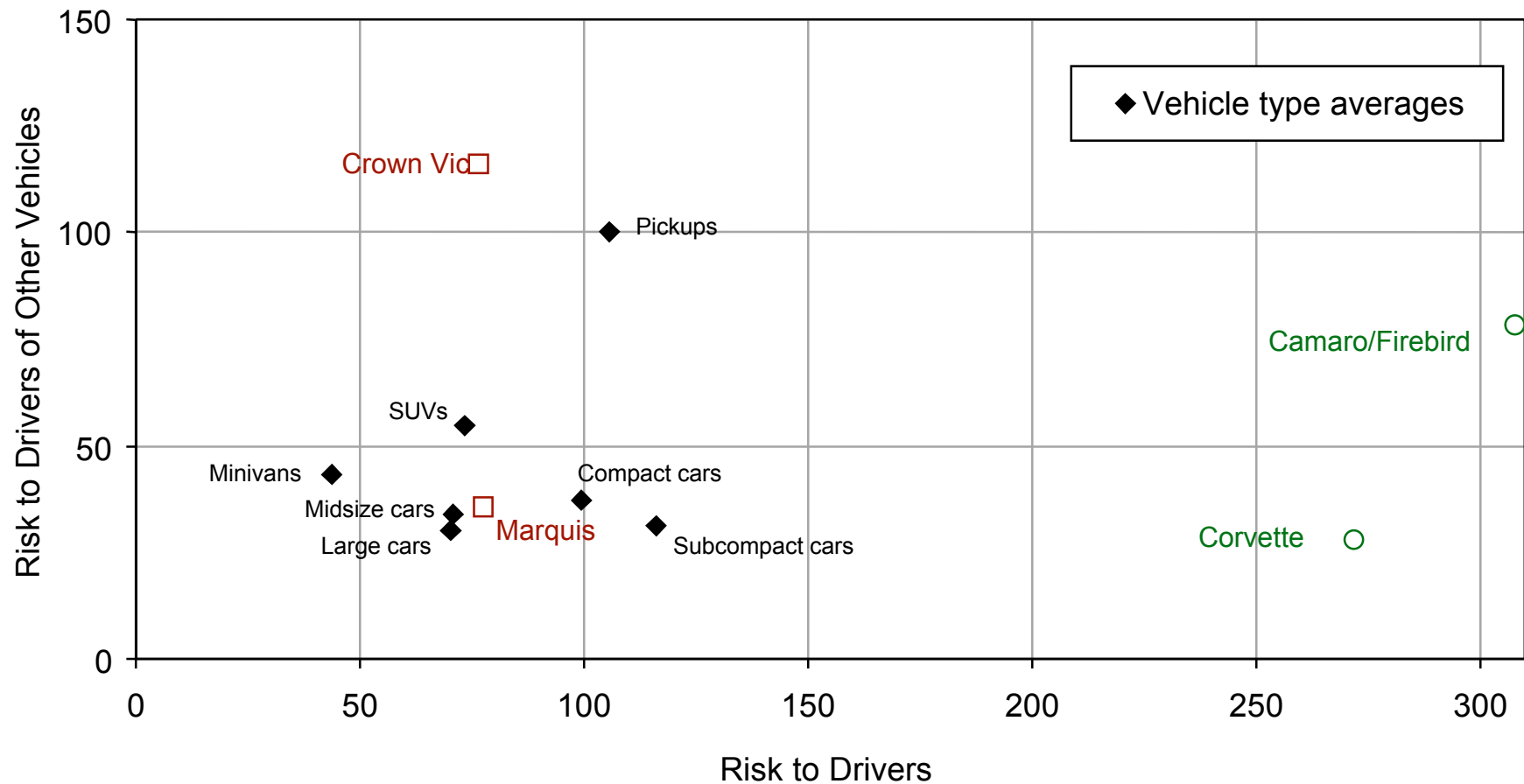
Driver Behavior Influences Risk

- Minivans have lowest risk to drivers, presumably because drivers are more careful
- Sports cars have highest risk to drivers
- Do import luxury cars attract low risk drivers? Or are they well designed?
- Driver characteristics that may affect risk
 - age and sex, driving history
 - seatbelt use
 - alcohol/drug use
 - education level/income
- Environmental variables that may affect risk
 - time of day (visibility)
 - weather (road conditions)
 - rural roads (poorly lit and designed, high speeds)

Suggestive Effect of Driver Behavior

- Ford Crown Victoria and Mercury Marquis are corporate twins
 - essentially same vehicle
 - similar risk to drivers, but Crown Vic has much higher risk to others
 - Crown Vic used as police vehicle; high risk to others reflects dangerous driving behavior
- Pontiac Camaro/Firebird and Chevy Corvette
 - both sports cars have high risk to drivers, perhaps because of driver behavior
 - but Corvette has much lower risk to others, perhaps because of its very low profile and fiberglass panels, which cause little damage when striking another vehicle

Difficult to Distinguish Effect of Driver Behavior from Vehicle Design



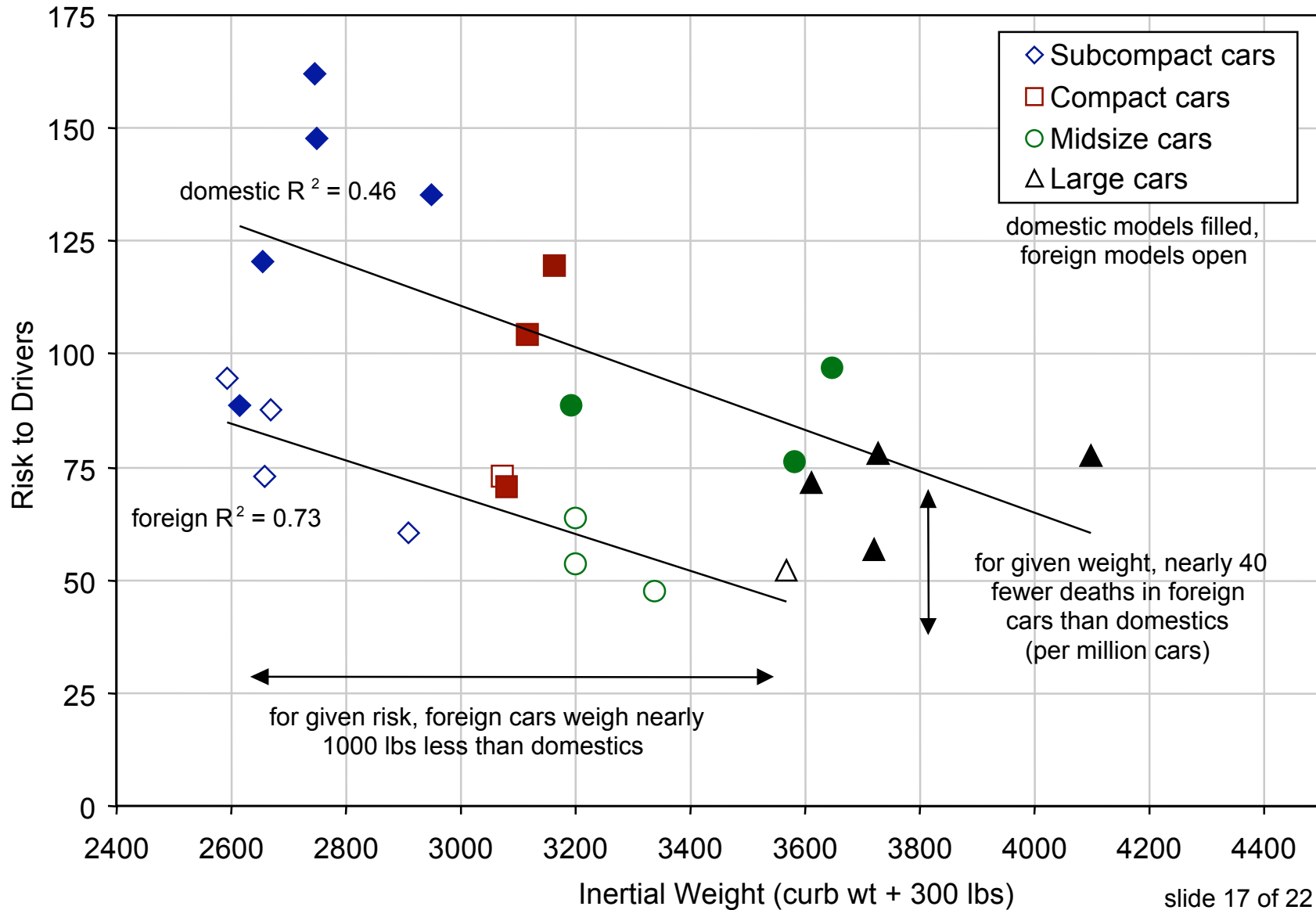
Effect of Driver Sex and Age on Risk

- Young males (<26) and elderly drivers (>65) are two highest risk groups
- Need exposure (vehicle sales or registrations) for each group to calculate the risk for each group
- Instead looked at fraction of driver fatalities in each group, by vehicle type
- SUVs have a lower fraction of both of these high-risk drivers than the average vehicle; therefore if we corrected for driver sex and age, SUV risks relative to other vehicle types would be slightly higher than shown
- Effect of driver sex and age on risk by vehicle model is not simple
 - large car models with highest risk to drivers have high fraction (>50%) of elderly fatalities (19% for all cars)
 - on other hand, safest subcompact models have high fraction (>30%) of young male fatalities (22% for all subcompacts)

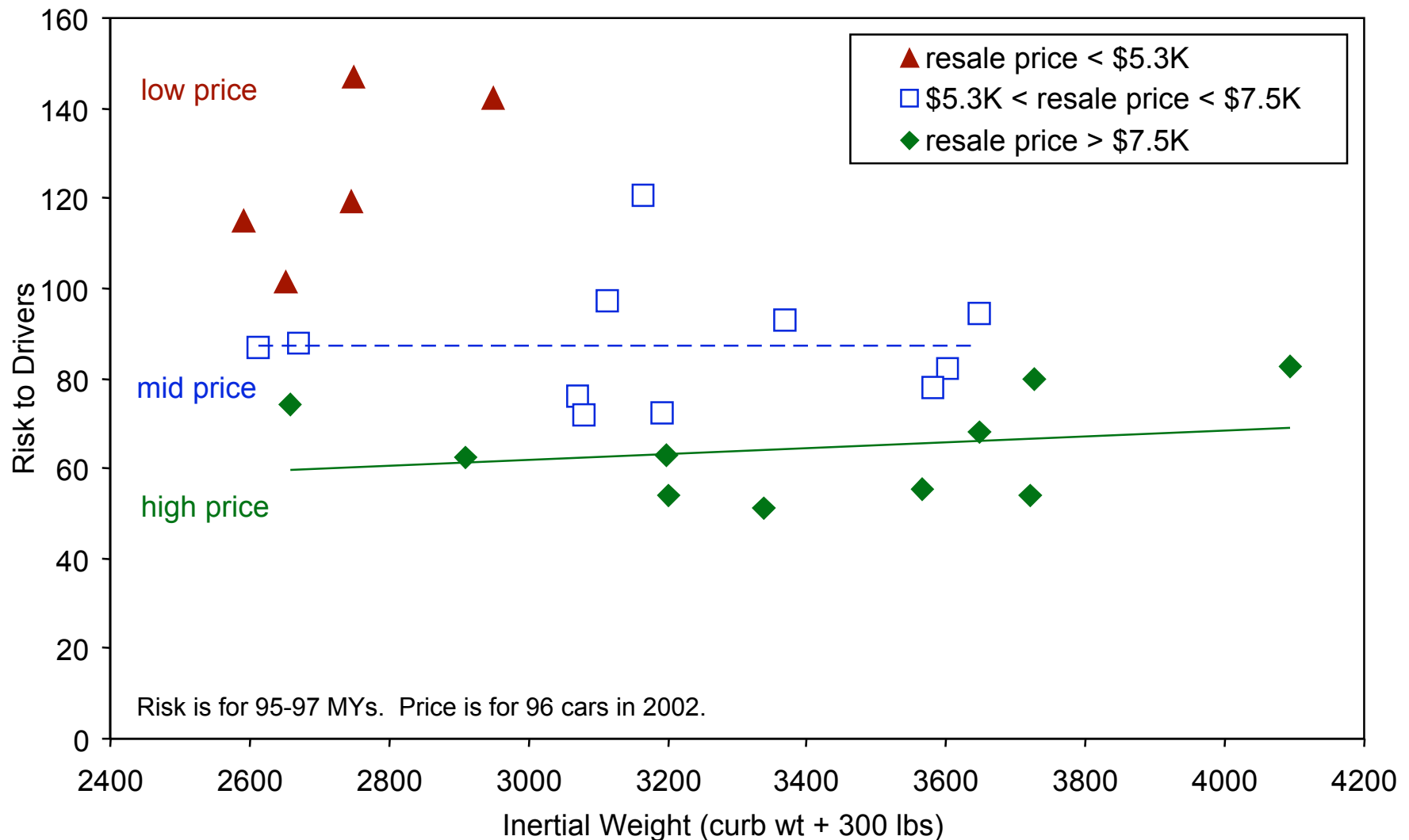
Is Car Weight a Good Predictor of Risk?

- NHTSA (1997) and DRI (2002) studies use car weight as the only car characteristic affecting risk
 - other variables (seatbelt use, airbags) not accounted for
 - assumes historical correlation between weight and size will continue into future (even with more extensive use of new lightweight materials)
- Quality of vehicle design appears a better predictor of risk than weight
- We analyze risk as a function of three measures of “quality”
 - corporate location of manufacturer
 - resale value (retail used car price from Kelley Blue Book)
 - Consumer Reports ratings
- Analysis limited to cars; need truck weights by “model” to apply to pickups, SUVs and minivans
- Results depend in part on how vehicles are grouped

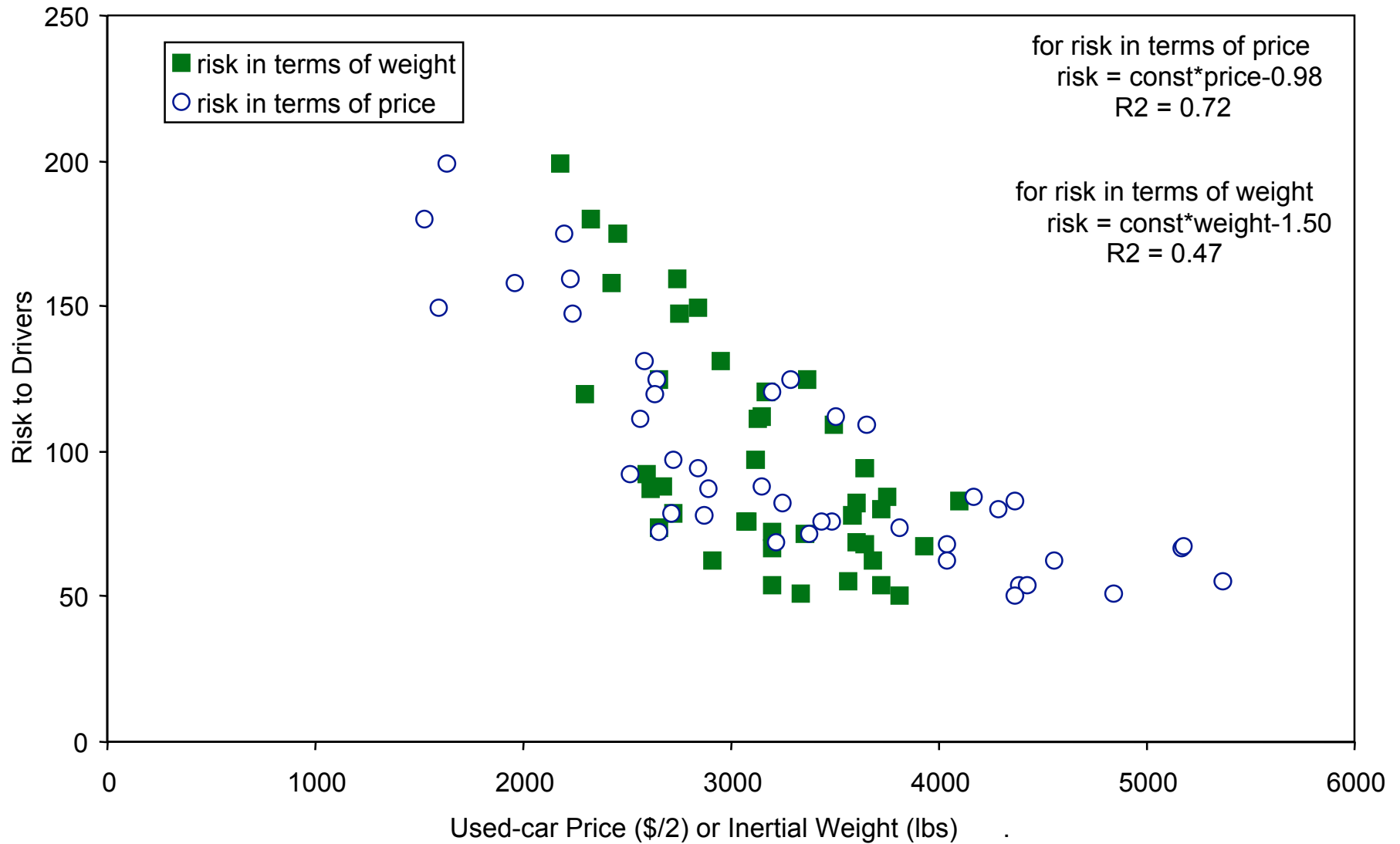
Foreign Car Models Have Lower Risk than Domestic Models of Same Weight



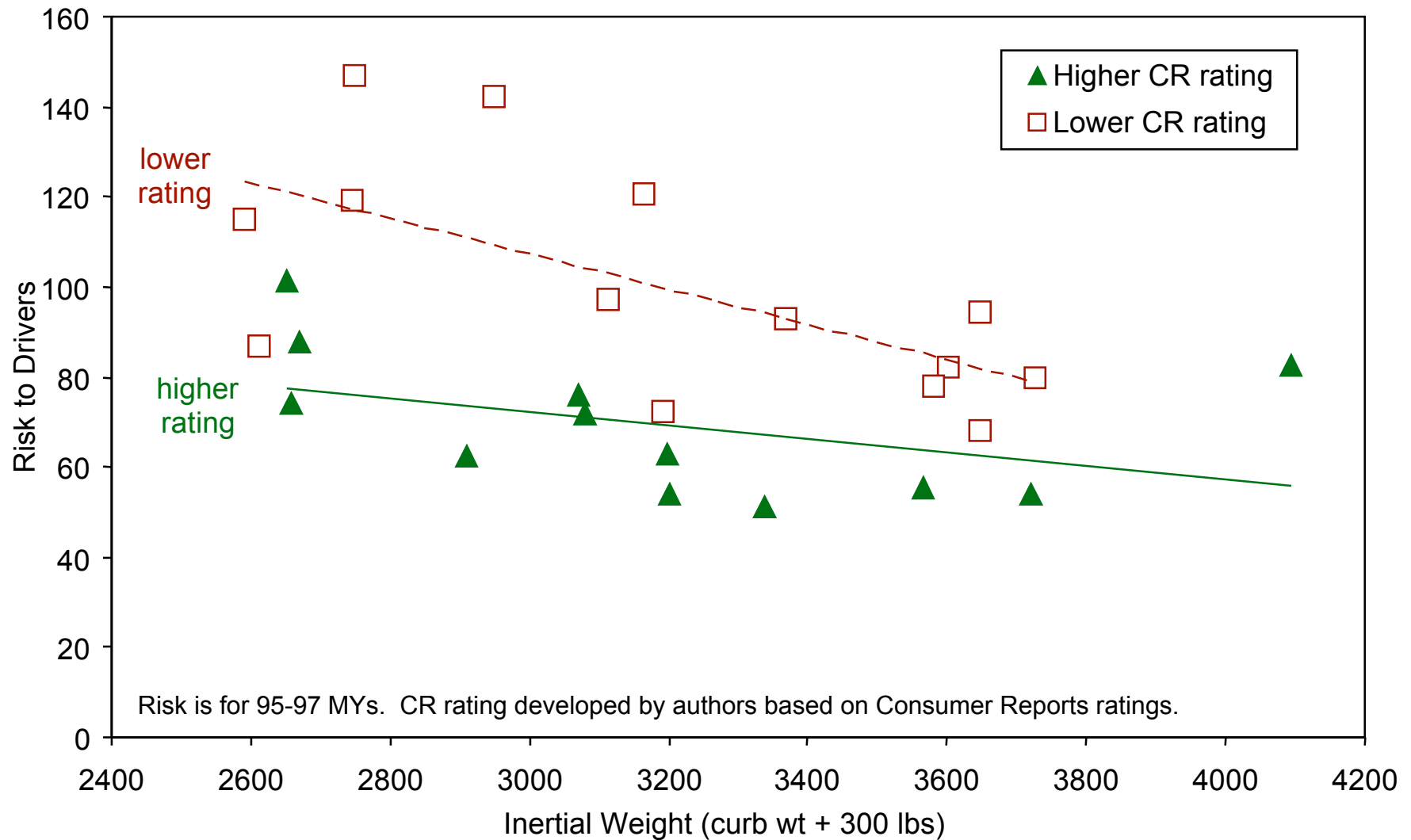
Accounting for Resale Value Removes Apparent Relationship between Car Weight and Risk



Stronger Correlation between Risk and Price than Risk and Weight



Consumer Reports Ratings



Summary of Findings

- Average midsize and large cars have same risk to drivers as average SUV
- Safest subcompact and compact cars have same risk to driver as average SUV
- Pickups and SUVs (and minivans) impose high risks on other drivers because of their incompatibility with cars
- Average subcompact and compact cars have similar combined risk as average SUV

Summary of Findings (cont.)

- Driver behavior influences what we call risk
 - low risk to drivers of minivans and high risk to drivers of sports cars
- Driver sex and age do not appear to influence our main findings by vehicle model
- However, other driver characteristics or environmental conditions (rather than vehicle design) may explain some of our findings
- Quality of vehicle design appears to be a better predictor of risk than vehicle weight